

Inequitable Effects of COVID-19 on Time Spent in Urban Nature Associated with Sense of Belonging: A Case Study of Seattle with Asian, Black, Latino, and White Residents

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Abstract: The COVID-19 pandemic has impacted basically everyone in urban areas. Some of these impacts in the United States have negatively affected People of Color more than their White counterparts. Using Seattle, Washington as a case study, we investigated whether inequitable effects would appear in residents' interactions with urban nature (such as urban green space), and, if so, why. Using a 48-question instrument developed for this study, 300 residents were surveyed, equally divided across 4 racial/ethnic groups: Asian, Black, Latino, and White. Results showed that during the span of about six months after the onset of the pandemic, Black and Latino residents experienced a significant loss of time in urban nature, while Asian and White residents did not. This decrease in the Black and Latino groups was partly explained by their feeling like they did not belong in their surrounding urban nature, as assessed by a newly developed measurement for Sense of Belonging. This measurement consisted of six themes: Ease of Access, Safety, Feeling Out of Place, Unwelcomeness, Institutional Acceptance, and Different Ways of Interacting with Nature Acceptance. These six themes provide guidance for how governmental agencies can promote more equitable access to urban nature during the pandemic and beyond.

Keywords: urban nature, green space, equity, sense of belonging, COVID-19; BIPOC

1. Introduction

This research lies at the intersection of three large conditions that are restructuring human lives and social systems. The first is recent: the COVID-19 pandemic. The second – and here we speak about the United States specifically – is the longstanding structural racism within society that continues to harm People of Color.¹ And the third is the increasing diminishment of nature on this planet, and in the lives of people. Because interacting with nature can help people physically and psychologically, it seems plausible that being in nature can buffer some of the pandemic's negative effects. Yet, if so, and given existing structural racism, it is also plausible that People of Color have not equally benefited.

In a nutshell, that is the motivation for this study. During COVID-19, People of Color in US cities have experienced more negative outcomes (compared to the White population), with a higher likelihood of COVID-19 infection, poorer COVID-19

¹ We recognize that the terms "People of Color" and "Communities of Color" can homogenize the experiences of different racial/ethnic groups. Terms like BIPOC (Black, Indigenous, and People of Color) are used to pull out the shared experiences of colonization among Black and Indigenous communities. In this study, however, this study's sample does not include indigenous people, therefore we chose to use People of Color and Communities of Color throughout this paper.

outcomes, higher stress and anxiety levels, and larger unemployment rates [1-6]. Thus, in this study we investigated whether the amount of time residents of Seattle, Washington spent in urban nature changed after six months of the pandemic, and, if so, how those changes varied across four racial/ethnic groups: Asian, Black and African American, Hispanic & Latino/a/x, and White.^{2, 3, 4}

1.1. The Importance of Assessing Race/Ethnicity when Investigating Urban Nature Visitation

One of the reasons why there may be inequities by race/ethnicity in changes of nature access during the pandemic is because of the history of racism in the US, which has led to historical differences in perceptions and use of urban nature. Finney [7] shows, for example, how urban parks were historically often places for acts of racism, and how these places can still convey racist sentiments for some Black individuals. Natural landscapes can be associated with lynchings, slavery, segregation policies, and events of conflict and violence [7-9]. By contrast, for many White individuals more “wild” or unkept nature harkens to a simpler time before industrialization, and represents a nostalgic longing for the past [7, 9].

An illustrative example that made national headlines occurred in May 2020 in Central Park, New York, when a White woman called the police on a Black man who was birdwatching in the park because the man had asked the woman to leash her dog in accordance with the law [10]. As Newsome [11] says:

For far too long, Black people in the United States have been shown that outdoor exploration activities are not for us, whether it be because the way the media chooses to present who is the ‘outdoorsy type’ or the racism experienced by Black people when we do explore the outdoors, as we saw recently in Central Park.

Drawing on the research literature, racial/ethnic inequities in access to urban nature appear in a multiplicity of ways. For one, White neighborhoods typically contain a higher density of urban nature areas compared to neighborhoods consisting in Communities of Color [12-16]. Second, the quality of urban nature is generally lower in Communities of Color [17]. Third, the upkeep of the urban nature is generally lower in Communities of Color [18, 19]. And fourth, social barriers to urban nature accessibility for people in Communities of Color can exist at the personal, institutional, or systemic level. These barriers include lack of multilingual signage, safety concerns, lack of free time, transportation limitations, cultural expectations and norms, and historically segregated park design [12, 20-22].

1.2. Effects of COVID-19 on Urban Nature Access Disaggregated by Race/Ethnicity

If measured as a homogenous group, some literature suggests that urban residents have increased their urban nature use during the pandemic [23]. For example, in a survey of land managers of urban parks across 12 US cities, 83% reported an increase in visitation to the spaces they manage [24].

But when disaggregating residents by race/ethnicity, the emerging studies show conflicting results. Larson et al. [25], for example, found that Black and Hispanic (compared to White) residents of cities across North Carolina, USA experienced a greater

² Throughout this paper, ‘Black or African American’ is shortened to ‘Black’.

³ Latinx and Latiné have been used as alternatives to Latino in efforts to be more gender inclusive [26-27]. We recognize that there are people who oppose the use of each of the terms Latino, Latinx, and Latiné within the Hispanic and Latino community [27-29]. We also recognize the issue with researchers, often outside the Hispanic and Latino community, imposing Western norms and altering the way that Hispanic and Latino individuals identify themselves and their community [28-29]. Here, Latino/a/x is used to be inclusive of those within the community who identify as Latino or Latina, and those who wish to use an ungendered term. Latino/a/x is shortened to Latino throughout this paper.

⁴ Urban nature in the case of this study refers to parks, green areas, open spaces, and places with water, vegetation, and/or animals within a city.

decrease in urban nature visitation six months after the start of the COVID-19 pandemic. Similarly, a study of New York City residents found that Black and Native American participants were more likely to experience a decrease in urban nature visitation during COVID-19 compared to Asian and White participants [30]. In contrast, other studies have found that People of Color living in cities have actually increased their time spent in urban nature during the COVID-19 pandemic. Pipitone and Jović [31], for example, found that nonwhite New York City residents increased their frequency of urban nature visitation during the first lockdown in New York City and again about four months after the pandemic started. Thus, to date, the research is not clear on the effects of the pandemic on nature access when disaggregating by race.

This study sought to help clarify this literature by means of an opening that we saw when reviewing the (above) literature on race/ethnicity and urban nature visitation. Namely, it appeared to us that one overarching construct that might help explain differences in nature access by racial/ethnic group is what we call *sense of belonging in urban nature*.

1.3. Sense of Belonging in Urban Nature

We mentioned earlier the incident of a White woman calling the police on a Black man who was birdwatching in Central Park. As argued by Roberts [22], this example carries forward a long history of racism that existed at the time when Central Park was built in the 1850's, when the park became an urban oasis for White people with privilege, and largely excluded People of Color. Roberts [22] argues it is not just Central Park where this exclusion continues to occur, but in many urban parks and green spaces nationwide. The empirical literature supports this proposition (e.g., Hoover & Lim [32], Joassart-Marcelli [33], and Wolch et al. [34]). For example, Byrne [12] conducted focus groups with Latina women living in Los Angeles, California near an urban national park. Most participants in this study expressed feeling 'out of place' and/or 'unwelcome' there. One Latina woman expressed worry that a resident would call the sheriff if they saw a Latino in a part of the park that was too close to the White neighborhoods.

Thus it may be the case that inequities in sense of belonging may play a large role in differences in urban nature visitation across racial/ethnic groups. To date, however, most assessments of sense of belonging has been on people's perceptions of their place within a broader community or social group. Hagerty et al. [35], for example, described belongingness as perceiving oneself as a part of and integral to the collective whole. Hagerty and Patusky [36] went on to develop the Sense of Belonging Instrument (SOBI), which includes items with imagery evoking social alienation. One example is an item that reads: "I feel like a square peg trying to fit into a round hole."

Other lines of investigation that touch on sense of belonging is sense of place, and place attachment. Sense of place is an overarching construct which describes one's feelings towards a place [37], while place attachment, a subset, more specifically refers to the positive connection between an individual and a specific place [38]. Peters et al. [39] used the idea of place attachment to better understand whether urban parks encourage social cohesion within a neighborhood. The study, which took place in the Netherlands, found that establishing an attachment to urban nature was associated with increased social cohesion amongst non-Western Dutch immigrants. For our purposes, the limitation with these bodies of literature is that they do not focus directly enough on experiences of exclusion, especially those due to a historical legacy of racism, in the context of urban nature.

One study that made a good step in this direction was by Pipitone and Jović [31]. They measured participants' sense of belonging in urban green space before and during the COVID-19 pandemic through a single Likert-scale question adapted from Rugel et al. [40] which reads: "How would you describe your sense of belonging to local parks or urban green space?" This study found no significant difference in sense of belonging

between White and nonwhite participants before COVID-19. Four months into the pandemic, White participants' sense of belonging was nearly significantly higher than nonwhite participants [31].

To the best of our knowledge, there is no existing scale or multi-item measurement which directly assesses sense of belonging in urban nature. Thus, this study sought to begin to create such a measurement, and then to use it in our present investigation.

1.4. The Present Investigation

In this study, we investigated whether there were inequitable effects during the early period of COVID-19 in terms of the experience of urban nature across four racial/ethnic groups residing in Seattle, Washington: Asian, Black, Latino, and White. More specifically we sought:

1. To characterize the type of urban nature that residents interacted with across the four racial/ethnic groups.
2. To develop a new measure for sense of belonging in urban nature, and to employ the measure across the four racial/ethnic groups.
3. To assess the frequencies of urban nature interactions before and during COVID-19 across the four racial/ethnic groups.
4. To test for differences in average change in frequency of urban nature interaction before and during COVID-19 across the four racial/ethnic groups.
5. To test whether there were inequitable effects of COVID-19 on frequency of urban nature interaction before and during COVID-19, and to test three possible explanatory variables: perceived coronavirus threat, perceived quality of nearby urban nature, and sense of belonging in urban nature, controlling for age, gender, income, and pre-pandemic frequency of urban nature interaction.

2. Materials and Methods

2.1. Study Site

Seattle is located in the state of Washington in the Pacific Northwest of the United States. Seattle has a population of 737,015 [41]. Of Seattle's population, 67.3% identifies as White, 15.4% Asian, 7.3% Black or African American, 6.7% Hispanic or Latino (of any race), 0.5% American Indian and Alaska Native, and 0.3% Native Hawaiian and other Pacific Islander. Those who identify as some other race constitute 0.3% of the Seattle population and those who identify as two or more races constitute 6.9%. The median household income of Seattle is \$92,263 [41].

Williams et al. [41] found Seattle to have less inequity in urban nature access compared to other major cities in the US including Atlanta, GA, Baltimore, MD, Detroit, MI, and Los Angeles, CA. Nonetheless, inequities in urban nature are prevalent. In Seattle, the amount of urban canopy cover in a given census tract is inversely correlated with the proportion of People of Color living in the census tract [43].

Seattle has a long history of racial segregation that has shaped the city. From 1910 to 1960, many Seattle housing property deeds contained clauses that explicitly prohibited People of Color or certain communities from renting or buying the property. By the 1920's, certain areas of what were called the Central District and Chinatown were the only "open neighborhoods" available to People of Color [44]. Today, Seattle's Central District and International District (formerly Chinatown) are composed of 35.5% and 66.8% nonwhite residents, respectively. Both the Central District and International District have significant gaps in urban nature accessibility [45].

2.2. Participant Recruitment

Convenience sampling was used to recruit participants online via the social media platforms Facebook and Instagram. Facebook and Instagram ads were run by study

researchers. These ads provided a short description of the study, advertised participant compensation, and provided a link to the study's eligibility questionnaire. A Facebook post with identical information to the ad was shared in various community Facebook Groups and Pages such as 'Seattle Latinx Pride', 'Families of Color Seattle', 'Mt. Baker Neighborhood, Seattle', and 'Beacon Hill Social Club'. The study description and eligibility questionnaire link were also distributed by study researchers to personal and professional connections via email to reach more potential participants.

Individuals interested in participating in the study were directed to an eligibility questionnaire hosted on Qualtrics where they provided responses used to determine eligibility. Prior to beginning the eligibility questionnaire, participants viewed a consent form and provided acknowledgement of consent. To be eligible for participation, individuals must have resided within Seattle city limits, lived in the same residence since at least fall 2019, be at least 18 years of age, be able to read and write English, and identify as Asian, Black or African American, Hispanic or Latino, or White. Individuals who identified as any other race/ethnicity or more than one race/ethnicity were not eligible. Eligible participants received a link to take the main survey after completing the eligibility questionnaire. Participants who completed the main survey received a \$10 Amazon gift card via email. This study was approved by the University's Institutional Review Board (IRB ID: STUDY00011290).

2.3. Data Collection

Data collection began in January of 2021 and concluded March 2021. A quota sampling technique was used to achieve an equal number of participants in each of the four included racial/ethnic groups (Asian, Black, Latino, and White). After receiving 75 responses from White participants, White participant recruitment ceased and the survey was modified so that only Asian, Black, and Latino individuals were eligible. Similarly, after 75 Asian responses were collected, Asian participant recruitment closed. 78 responses from Latino individuals and 80 responses from Black individuals were received before the survey fully closed. 75 participant responses were randomly sampled from each of these two groups to achieve an equal sample size between the four racial/ethnic groups.

2.4. Participant Characteristics

The sample consisted of 300 participants with 75 participants in each racial/ethnic group (Asian, Black, Latino, and White). Participants indicated their total household income via income categories. The median annual household income category for the sample was \$75,000-\$99,000, encompassing the Seattle median of \$92,263 [41]. There were slightly more females (56%) than males (42%) in the sample. Participants provided their age according to age categories, with the median age category being 25-34 years old. This is just under the median Seattle age of 34.7 years old [41].

2.5. Survey Instrument

A 25-minute survey consisting of 48 multiple-choice, Likert-scale, and open-ended questions was administered to participants. This online survey was hosted on Qualtrics. The survey sought to capture changes in urban nature visitation six months into the pandemic as well as evaluate participants' urban nature perceptions and values. The following definition of urban nature was given to participants before and throughout the survey: Urban nature refers to parks, green areas, open spaces, and places with water, vegetation, and/or animals within the city of Seattle. Urban nature does not include things you may pass by briefly, such as trees along a sidewalk. Nature elements which one may pass by briefly, such as urban street trees, were not included as urban nature for this study so as to place more emphasis on urban nature spaces one may intentionally seek to spend time in.

To understand how participants' urban nature use changed as a result of the COVID-19 pandemic, a set of questions were given twice within the survey. The first time, participants were asked to reflect back to their experiences in fall 2019 (before the COVID-19 pandemic). Participants were then given the same set of questions and asked to respond according to their recent experiences in fall 2020 (about six months into the COVID-19 pandemic). Fall was chosen as the reference period for both before the pandemic and during the pandemic. One reason for this was to reduce variability that may be due to different levels of outdoor activity throughout the year. The second time point was positioned six months into the COVID-19 pandemic in an attempt to accurately represent how the pandemic may affect urban residents long term. The immediate changes to urban nature interaction during the early months of the COVID-19 pandemic may be more extreme or different than those changes seen further into the pandemic. With future disruptive events possibly affecting urban life for extended periods of time, a moderately long time span of six months may be most appropriate when assessing the impacts of the event.

2.6. Measures

The key measurements and scales included in this survey are below.

Types of Urban Nature Interaction. To attain some specificity in Seattle residents' urban nature interactions, this survey asked about the types of urban nature activities participants engaged in. Participants were given a list of 20 common activities in urban nature such as walking a dog and having a picnic. They were asked to indicate all urban nature activities which they had enacted in fall 2019 and fall 2020.

Frequency of Urban Nature Interaction. Within this group of pre- and during COVID-19 questions, participants were asked about how frequently they spent time in urban nature in fall 2019 and fall 2020. This question read: "Over the course of fall [2019 or 2020], how frequently did you spend time in or around urban nature?" Participants responded to this multiple-choice question with how many days per week, on average, they spent time in or around urban nature in fall 2019 (before the pandemic) and fall 2020 (about six months into the pandemic). Multiple choice response options included: *Less than once per month, 1-3 times per month, once per week, 2-3 days per week, 4-5 days per week, 6 days per week, and Daily*. These responses were converted to days per month. The average of each response option was used (e.g., *Less than once per month* was replaced with 0 days per month, *2-3 days per week* was replaced with 10 days per month, and *Daily* was replaced with 28 days per month).

Urban Nature Conservation Values. A single Likert-scale question was used to measure participants' level of importance of urban nature conservation in order to test for association with sense of belonging in urban nature. One's urban nature conservation values were assessed through the question: "How important to you is the protection of urban nature?" The 5-point Likert question response options ranged from *not at all important* (1) to *very important* (5).

Perceived Coronavirus Threat Questionnaire (short). Three measures were explored as possible explanatory variables for the differences in the effects of COVID-19 on urban nature interaction frequency. The first was the short version of the Perceived Coronavirus Threat Questionnaire, developed and validated by Conway et al. [46]. This scale is used to assess the level of which participants were fearful of the COVID-19 virus. This shortened scale was modified from a 7-point Likert-scale to a 5-point Likert-scale ranging from *not at all true of me* (1) to *very true of me* (5). The scale includes three items which read: "Thinking about the coronavirus (Covid-19) makes me feel threatened."; "I am afraid of the Coronavirus (Covid-19)."; "I am stressed around other people because I worry I'll catch the coronavirus (Covid-19)." Cronbach's alpha for the Perceived Coronavirus Threat Questionnaire in this study was 0.74.

Perceived Green Space Quality Scale. The second measure explored as a possible explanatory variable for the differences in the effects of COVID-19 on urban nature interaction frequency was the Perceived Greenspace Quality Scale [47]. As previously noted, urban nature quality is a key dimension of accessibility, and can provide insight into why an urban nature spot might not be visited. This scale was adapted by replacing the term “greenspace” with “urban nature”. The 10-point Likert-scale was converted to a 5-point Likert-scale ranging from *completely disagree* (1) to *completely agree* (5). Examples of items in this scale include: “My neighborhood has safe urban nature spots.”; “My neighborhood has well-maintained urban nature spots.”; “My neighborhood has beautiful urban nature spots.” Cronbach’s alpha for the Perceived Greenspace Quality Scale in this study was 0.84.

Sense of Belonging in Urban Nature Questionnaire. The third measure we sought to explore as a possible explanatory variable for the differences in the effects of COVID-19 on urban nature interaction frequency was sense of belonging in urban nature. No existing measurement fit the requirements for this measure, so a questionnaire was developed for this study. This measure, called the Sense of Belonging in Urban Nature Questionnaire, was intended to better understand experiences of inequity in urban nature, specifically as it relates to one’s sense of belonging. Each of the six items in this questionnaire correspond to a larger overall theme of inequity distilled from the existing literature. (See Table 1 for all items and corresponding literature). Participants responded to each item on a 5-point Likert-scale ranging from *completely disagree* (5) to *completely agree* (1). Internal reliability of this questionnaire was high (Cronbach’s alpha= 0.84), however this questionnaire remains unvalidated.

The Sense of Belonging in Urban Nature Questionnaire is composed of six themes which characterize six racial/ethnic inequities. These inequities were identified through a literature review of social barriers to urban nature use among People of Color and the resulting feelings of exclusion. The themes included in the sense of belonging measurement are by no means the only ways in which Communities of Color feel excluded from urban nature. Nor are they likely uniform for experiences across all Communities of Color. The themes of inequity included in the exploratory Sense of Belonging in Urban Nature Questionnaire are intended to characterize broad ways in which exclusion presents. The sense of belonging inequity themes are Ease of Access, Safety, Feeling Out of Place, Unwelcomeness, Institutional Acceptance, and Different Ways of Interacting with Nature Acceptance. See Table 1 for source literature for each theme. Descriptions of these inequity themes are below:

- **Ease of Access.** This theme characterizes difficulties in spending time in urban nature due to socioeconomic inequities including proximity to nearby urban nature, poor quality of nearby urban nature, lack of free time, and transportation limitations.
- **Safety.** One is less likely to feel a sense of belonging in urban nature if spending time in urban nature poses a risk to personal safety or the safety of others.
- **Feeling Out of Place.** This theme seeks to capture feelings of not belonging or fitting in within the landscape. There are several factors that may lead to one feeling out of place in urban nature spaces. Some include having very limited representation of People of Color in nature spaces, cultural expectations and norms, and being the only Person of Color in an urban nature space.
- **Unwelcomeness.** Feelings of not belonging in urban nature can arise from external exclusion from those in the White majority. Overt and covert messages from White individuals in urban nature spaces can send a clear message of unwelcomeness to People of Color in the space.
- **Institutional Acceptance.** If People of Color are not accepted in urban nature on an institutional level, urban nature spaces and management practices will reflect that. People of Color may feel that urban nature areas were not created for them, with the design catering to typically Eurocentric ways of interacting with urban nature. People of Color also experience conflicts with those who manage urban nature spaces due to their presence in these spaces.

- **Different Ways of Interacting with Nature Acceptance.** People of Color may feel that the way they use urban nature is not deemed acceptable or welcome by others.

Table 1. The Sense of Belonging in Urban Nature Questionnaire.

Theme	Item
Ease of Access [12, 16, 48, 52, 54, 56, 58, 60]	<i>"It is not easy for me to get to a park or other urban nature spot near my home."</i>
Safety [8, 12, 19, 53, 56, 57-58]	<i>"When in an urban nature spot near my residence, I fear for my own safety or the safety of others around me."</i>
Feeling Out of Place [12, 19, 39, 50, 57]	<i>"I feel out of place in the urban nature spots I visit."</i>
Unwelcomeness [8, 12, 39, 58]	<i>"I feel unwelcome by others when in urban nature."</i>
Institutional Acceptance [8, 12, 20-21, 50, 59]	<i>"I feel uncomfortable when I see a park management employee when in urban nature."</i>
Different Ways of Interacting with Nature Acceptance [8, 12, 39, 49, 51, 55]	<i>"I feel that the way I use urban nature is unwelcome or unaccepted by other visitors."</i>

2.7. Analysis

Participants' frequencies of urban nature interaction in fall 2019 (before COVID-19) and fall 2020 (six months into COVID-19) were first compared between racial/ethnic groups. The Kruskal-Wallis non-parametric equivalent to ANOVA was conducted to test whether any pair(s) of racial/ethnic groups had significantly different frequencies of urban nature interaction in fall 2019. Dunn's test for stochastic dominance was then used to identify which pair(s) of racial/ethnic groups significantly differed in frequency of urban nature interaction in fall 2019. The "dunnTest()" function in R was used with the specification that the comparisons were one-sided. One-sided post hoc tests allow for the results to speak of directionality. The Bonferroni method was used to adjust the p-values of this post hoc test to reduce the familywise error rate associated with multiple testing. The same process was then conducted to compare groups' 2020 frequencies.

We used two linear regression analyses to test whether sense of belonging was significantly associated with 2019 frequency of urban nature interaction and/or 2020 urban nature interaction. Control variables were included in each regression model for race/ethnicity, age, gender, and income.

To test whether a given racial/ethnic group experienced a significant change in frequency of urban nature interaction, the average 2019 and 2020 frequencies were first calculated for each group. One-tailed paired-sample t-tests were then conducted within each racial/ethnic group to compare their 2019 and 2020 average frequencies. Although the distributions for 2019 and 2020 reported frequencies of urban nature interaction are mildly non-normal, the sample size (300 total, 75 participants in each racial/ethnic group) is large enough to justify the use of Student's t-test. The tests were directional because each group's 2020 average frequency was observed, descriptively, to be either greater or less than their 2019 frequency. If these tests were significant, it meant the racial/ethnic group experienced a significant increase or decrease (depending on the directionality of the test) in frequency of urban nature interaction from fall 2019 to fall 2020.

It was then tested whether the COVID-19 pandemic impacted frequency of urban nature interaction differently across racial/ethnic groups. The Kruskal-Wallis test was conducted to test whether the observed changes in frequency were different across

racial/ethnic groups. Given that this test was significant, one or more pairs of racial/ethnic groups experienced significantly different effects of COVID-19 on their frequency of urban nature interaction. Dunn's test for stochastic dominance was then used to identify which pair(s) of racial/ethnic groups significantly differed in observed change to frequency of urban nature interaction. A one-sided Dunn's test was used for post-hoc comparisons in order to speak about directionality of significant differences. The Bonferroni method was used to adjust the p-values of this post hoc test.

A stepwise regression analysis was conducted to test whether perceived coronavirus threat, perceived urban nature quality, or sense of belonging in urban nature could explain differences in the effects of COVID-19 on frequency of urban nature interaction. Control variables (age, gender, income, and pre-pandemic frequency) were introduced to better isolate the effects of racial/ethnic inequities. Age was converted from categorical responses to integers by taking the average of the multiple response options for age (e.g., 18-24 years old was replaced with 21). Average annual income categories were similarly replaced with the average for that response category and rounded to the nearest whole dollar (e.g., \$50,000 to \$74,999 was replaced with 62500). Less than \$25,000 was replaced with 24999 and \$200,000 or more was replaced with 200000. Pre-pandemic frequency of urban nature interaction was included as a control variable as those with a high 2019 (pre-pandemic) frequency have the potential for a larger decrease in average days per month than those with a lower 2019 frequency (and vice versa for those who start with a low 2019 frequency). Perceived coronavirus threat, perceived quality of urban nature, and sense of belonging variables were added to a regression formula with the control variables. The dependent variable of this regression formula was change in frequency of urban nature interaction. A forward and backward variable selection process was automated using the "step()" command in R to select a formula-based linear regression model based on AIC. This stepwise regression analysis removes any independent variables which do not significantly contribute to predicting the outcome variable. Both control and explanatory variables were permitted to be removed in this process. The "step()" function returns a regression formula that includes the independent variables which best predict the outcome variable for that specific data set.

We used a Kruskal-Wallis test to observe whether sense of belonging significantly varied across racial/ethnic groups. We then used Dunn's test for stochastic dominance to identify which pair(s) of racial/ethnic groups significantly differed in sense of belonging. A one-sided Dunn's test was used for post-hoc comparisons in order to speak about directionality of significant differences in belonging. The Bonferroni method was used to adjust the p-values of this post hoc test.

The association between one's level of importance of urban nature conservation and their sense of belonging in urban nature was explored using a linear regression model. Importance of urban nature conservation was regressed onto several control variables (race/ethnicity, age, gender, and income) and responses to the Sense of Belonging in Urban Nature Questionnaire. The covariate p values were used to assess whether sense of belonging significantly predicted urban nature conservation values.

To analyze the types of urban nature interactions participants engaged in, frequencies of occurrence for each activity in fall 2019 and fall 2020 were descriptively compared. Comparisons were made for the entire sample as well as within each racial/ethnic group.

Data were analyzed in RStudio version 1.4.1103. Statistical significance was $\alpha = 0.05$ for all analyses.

3. Results

3.1. Types of Urban Nature Interactions

Prior to the pandemic, participants of this sample took walks with other people more frequently than they took walks alone. Six months into the pandemic, participants more frequently took walks alone than took walks with other people (see Table 2 for frequencies of each activity before and during the pandemic). This pattern holds true within each racial group except for Latino and White participants. Latino participants more frequently took walks alone before the pandemic. White participants more frequently took walks with other people during the pandemic.

Table 2. Types of urban nature interaction before and during the COVID-19 pandemic.

Urban Nature Interaction ¹	Frequency (%)									
	n= 300		Asian (n=75)		Black (n= 75)		Latino (n=75)		White (n=75)	
	Before	During	Before	During	Before	During	Before	During	Before	During
Took a walk with other people	194 (65)	137 (46)	53 (71)	38 (51)	37 (49)	15 (20)	40 (53)	24 (32)	64 (85)	60 (80)
Took a walk alone	179 (60)	164 (55)	51 (68)	47 (63)	26 (35)	24 (32)	44 (44)	36 (48)	58 (77)	57 (76)
Sat in nature	155 (52)	116 (39)	38 (51)	30 (40)	24 (32)	18 (24)	40 (53)	24 (32)	53 (71)	44 (59)
Enjoyed the stillness and quietness of nature	153 (51)	129 (43)	39 (53)	29 (39)	28 (37)	21 (28)	40 (53)	35 (47)	46 (61)	44 (59)
Watched the sunrise or sunset	137 (46)	108 (36)	32 (43)	14 (19)	14 (15)	20 (27)	36 (48)	26 (35)	55 (73)	48 (64)
Looked out at a large view of water	135 (45)	112 (37)	41 (55)	34 (45)	9 (12)	8 (11)	32 (43)	20 (27)	53 (71)	50 (67)
Ran or jogged	129 (43)	72 (24)	34 (45)	19 (25)	30 (40)	12 (16)	37 (49)	17 (23)	28 (37)	24 (32)
Looked out at a large view of the city	97 (32)	77 (26)	31 (41)	24 (32)	4 (5)	1 (1)	19 (25)	13 (17)	43 (57)	39 (52)
Had a picnic	94 (31)	57 (19)	27 (36)	18 (24)	9 (12)	1 (1)	23 (31)	13 (17)	35 (47)	25 (33)
Looked at wildlife	84 (28)	71 (24)	23 (31)	13 (17)	5 (7)	2 (3)	14 (19)	10 (13)	42 (56)	46 (61)
Rode a bike	83 (28)	62 (21)	16 (21)	11 (15)	11 (15)	6 (8)	21 (28)	15 (20)	35 (47)	30 (40)
Walked a dog	65 (22)	67 (23)	13 (17)	14 (19)	11 (15)	11 (15)	19 (25)	18 (24)	22 (29)	24 (32)
Tended to a garden	57 (19)	60 (20)	10 (13)	12 (16)	7 (9)	6 (8)	11 (15)	11 (15)	28 (37)	31 (41)
Played a sport	53 (18)	19 (6)	20 (27)	8 (11)	11 (15)	3 (4)	13 (17)	3 (4)	9 (12)	5 (7)
Watched my children play	49 (16)	36 (12)	13 (17)	9 (12)	17 (23)	11 (15)	10 (13)	9 (12)	9 (12)	7 (9)
Used a water vessel such as a kayak, canoe, paddle board, or sailboat	44 (15)	30 (10)	6 (8)	7 (9)	3 (4)	1 (1)	10 (13)	2 (3)	25 (33)	20 (27)
Collected berries, nuts, mushrooms, greens, or other edible items	44 (15)	29 (10)	11 (15)	8 (11)	4 (5)	1 (1)	8 (11)	3 (4)	21 (28)	17 (23)
Swam or submerged in water	37 (12)	24 (8)	5 (7)	5 (7)	4 (5)	2 (3)	9 (12)	3 (4)	19 (25)	14 (19)
Rode a skateboard or scooter	18 (6)	12 (12)	3 (4)	1 (1)	3 (4)	0 (0)	4 (5)	5 (7)	8 (11)	6 (8)
Volunteered with an organization outside	14 (5)	5 (2)	4 (5)	0 (0)	0 (0)	1 (1)	4 (5)	0 (0)	6 (8)	4 (5)

Other	5 (2)	5 (2)	0 (0)	1 (1)	0 (0)	1 (1)	0 (0)	0 (0)	5 (7)	3 (4)
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¹The above types of interaction were presented to participants in a multiple-choice question. They were asked to indicate all that they had enacted at each time point.

3.2. Sense of Belonging in Urban Nature

White participants descriptively responded with the highest sense of belonging in urban nature (M= 25.31, SD= 4.4) followed by Asian (M= 23.24, SD= 4.62), Latino (M= 20.12, SD= 5.21), and Black participants (M= 18.56, SD= 4.75) (see Figure 1, Table 3). A Kruskal-Wallis test shows disparities in sense of belonging in urban nature across racial/ethnic groups ($p < .001$). White participants had a significantly higher sense of belonging in urban nature than that of Latino (adjusted $p < .001$) and Black participants (adjusted $p < .001$). Sense of belonging among Asian participants was significantly higher than that of Latino (adjusted $p < .002$) and Black (adjusted $p < .001$) participants.



Figure 1. Average Sense of Belonging in Urban Nature Among Each Racial/Ethnic Group.

Using a linear regression with control variables for race/ethnicity, age, gender, and income, sense of belonging in urban nature was found to significantly predict participants' reported importance of urban nature conservation ($p = .02$). Participants with a higher sense of belonging in urban nature put a higher level of importance on urban nature conservation.

3.3. Frequencies of Urban Nature Interaction Before and During COVID-19

In fall 2019 (before the COVID-19 pandemic), White participants spent time in or around urban nature most frequently with an average of 11.20 days per month (SD= 8.43) (see Table 4). This was followed by Black (M=8.32, SD= 6.50) and Latino participants (M= 7.65, SD= 6.40). White participants did not spend time in urban nature significantly more frequently than Black (adjusted $p = .584$) or Latino participants (adjusted $p = .064$) during this time. Average frequency of urban nature interaction for Asian participants (M= 7.81) was significantly lower than that of White participants (M= 7.81, adjusted $p = .004$).

About six months after the start of the pandemic (in fall 2020), White participants still had the most frequent urban nature interaction with an average frequency of 12.35 days per month (SD= 8.99). Asian participants had the next most-frequent urban nature use with an average of 7.09 days per month (SD= 8.47). This was followed by Latino participants (M= 5.55, SD= 7.12) and Black participants (M= 4.56, SD= 6.24). About six months after the pandemic began, the average frequency of urban nature interaction among White participants was significantly higher than that of Asian (adjusted $p < .01$), Latino (adjusted $p < .001$), and Black participants (adjusted $p < .001$). The Asian, Latino, and Black frequencies did not significantly differ from each other.

Table 3. Average measurement values across racial/ethnic groups.

	Measurement Average (SD)			
	Asian	Black	Latino	White
2019 Frequency ¹	7.81 (8.21)	8.32 (6.50)	7.65 (6.40)	11.20 (8.43)
2020 Frequency ¹	7.09 (8.47)	4.56 (6.24)	5.55 (7.12)	12.35 (8.99)
Change in Frequency (δ) ¹	-0.72 (8.08)	-3.76 (6.42)	-2.12 (6.75)	1.15 (8.56)
Perceived Coronavirus Threat (Low: 3, High: 15)	12.15 (2.08)	12.88 (1.70)	12.25 (1.99)	11.87 (2.61)
Perceived Urban Nature Quality (Low: 6, High: 30)	24.07 (4.09)	21.76 (4.78)	22.31 (4.15)	24.61 (4.99)
Sense of Belonging in Urban Nature (Low: 6, High: 30)	23.24 (4.62)	18.56 (4.75)	20.12 (5.21)	25.31 (4.41)
Level of Importance of Urban Nature Conservation (Low: 1, High: 5)	4.80 (0.40)	4.44 (0.78)	4.64 (0.63)	4.97 (0.16)

¹ Frequencies of urban nature interaction and change in frequency of urban nature interaction are given in average number of days per month.

3.4. Average Change in Frequency of Urban Nature Interaction

This study investigated whether COVID-19 had an effect on each racial/ethnic group's frequency of urban nature interaction. There was no significant difference in the frequency of urban nature interaction for White and Asian participants from fall 2019 to fall 2020. Latino and Black participants, however, experienced a significant decrease in frequency of urban nature interaction six months into the COVID-19 pandemic (see Figure 2).

White participants experienced **no significant change** in average days per month spent in urban nature from fall 2019 to fall 2020 ($\delta = 1.15$; $p = .125$; $H_0 : \delta \neq 0$; 95%CI_{low}: -0.50).

Asian participants experienced **no significant change** in average days per month spent in urban nature from fall 2019 to fall 2020 ($\delta = -0.72$; $p = .222$; $H_0 : \delta \neq 0$; 95%CI_{high}: 0.84).

Latino participants experienced a **significant decrease** in average days per month spent in urban nature from fall 2019 to fall 2020 ($\delta = -2.12$; $p < .004$; $H_a : \delta \leq 0$; 95%CI_{high}: -0.81).

Black participants experienced a **significant decrease** in average days per month spent in urban nature from fall 2019 to fall 2020 ($\delta = -3.76$; $p < .001$; $H_a : \delta \leq 0$; 95%CI_{high}: -2.53).

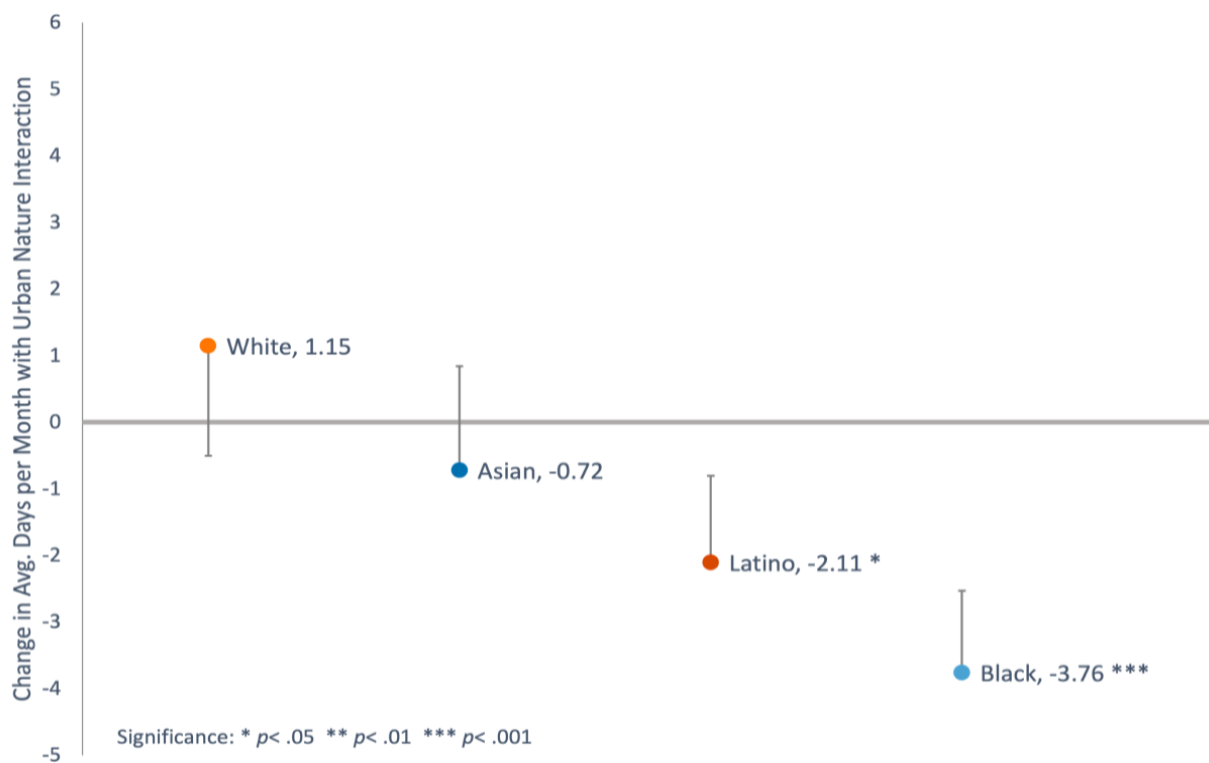


Figure 2. Change to average frequency of urban nature interaction among each racial/ethnic group.

To test whether COVID-19 impacted frequency of urban nature interaction significantly unequally amongst racial/ethnic groups, changes to frequency of urban nature interaction were compared across racial/ethnic groups. The Kruskal-Wallis non-parametric equivalent to ANOVA was used. This test was significant ($p < 0.001$), meaning the COVID-19 pandemic did not impact frequency of urban nature interaction equally across racial/ethnic groups.

Black participants were impacted to a greater degree than White participants (adjusted $p < .001$). Latino participants were impacted to a greater degree than White participants (adjusted $p = .009$). Black participants' frequency of urban nature interaction was also impacted significantly more than that of Asian participants (adjusted $p = .009$). No other pairings of racial/ethnic groups significantly differed in change to frequency of urban nature interaction.

3.5. Explanatory Variables for the Inequitable Effects of COVID-19

With the observed disparate outcomes in frequency of urban nature interaction during COVID-19, it was tested whether other measures of inequities may predict this disparity. Perceived coronavirus threat, perceived quality of nearby urban nature, and sense of belonging in urban nature are all variables which may have predicted inequitable effects of COVID-19 on frequency of urban nature interaction. Control variables for age, gender, income, and pre-pandemic frequency of urban nature interaction were included in this analysis.

An automated forward and backward stepwise regression analysis was conducted on a regression formula with change in frequency of urban nature interaction from 2019 to 2020 as the dependent variable. The model's independent variables included race/ethnicity, perceived coronavirus threat, perceived quality of nearby urban nature, sense of belonging, and the control variables. This starting regression model had an AIC of 1142.71 (see Table 4 for the stepwise variable selection process).

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Table 4. The automated stepwise variable selection process.

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Step		Df	Deviance	Resid. Df	Resid. Dev	AIC
0		NA	NA	287	12408.43	1142.71
1	- Gender	3	58.69	290	12467.13	1138.12
2	- Income	1	0.05	291	12467.17	1136.12
3	- Perceived coronavirus threat	1	3.17	292	12470.34	1134.20
4	- Perceived urban nature quality	1	13.56	293	12483.90	1132.52

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Based on AIC, the stepwise variable selection determined that race/ethnicity, age, pre-pandemic frequency of urban nature interaction, and sense of belonging best predict the changes to frequency of urban nature interaction of this study's sample (AIC= 1132.52). To attain the smallest AIC value, perceived coronavirus threat, perceived quality of nearby urban nature, gender, and income variables were removed from the regression formula. This result shows that the effects of COVID-19 on frequency of urban nature interaction are associated with sense of belonging in urban nature. Participants with a lower sense of belonging in urban nature lost more time in urban nature during COVID-19.

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With sense of belonging in urban nature significantly contributing to changes in frequency of urban nature interaction from 2019 to 2020, we tested whether sense of belonging was significantly associated with either 2019 frequency of urban nature interaction or 2020 urban nature interaction. Sense of belonging in urban nature did not significantly predict frequency of urban nature interaction in fall 2019 ($p= .211$) but did predict frequency of urban nature interaction in fall 2020 ($p= .001$).

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4. Discussion

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In the last decade, the research has become increasingly clear that accessing and interacting with nature is important for people's physical and mental wellbeing (see, e.g., Bratman et al. [61]; Frumkin et al. [62] for comprehensive reviews). Nature experience is linked, for example to improved immune functioning, reduced diabetes, lower blood pressure, better eyesight, improved postoperative recovery, and reduced mortality; and to increased positive affect, improved manageability of life tasks, and decreases in mental distress. Thus, during the beginnings of a pandemic – during a time of enormous uncertainty and hardship on individuals, communities, and social systems – it seems to us prima facie obvious that it would be good if all people could access nature, and thereby potentially buffer some of the negative physical and mental outcomes caused by the pandemic.

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Within this framing – and with an equity focus – we investigated residents' change of frequency of nature access during the first six months of the pandemic across four racial/ethnic populations in Seattle. We found that Black and Latino Seattle residents experienced a significant decrease in their frequency of urban nature interaction while Asian and White residents experienced no change. This is not to say, however, that Asian Seattle residents in other ways were not disproportionately affected by the pandemic

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during this time. They were. For example, hate crimes against Asian Seattle residents increased 56% from 2019 to 2020 [63].

What might have contributed to these inequitable outcomes for the Black and Latino residents? This question may be partially addressed through the results from the Sense of Belonging questionnaire. Results showed that a sense of belonging in urban nature was found to be significantly associated with participants' changes in frequency of urban nature interaction during COVID-19. Specifically, those with a lower sense of belonging (Black and Latino residents) experienced a greater loss of time in urban nature, while those with a higher sense of belonging (Asian and White residents) experienced no change.

While sense of belonging in urban nature was significantly associated with frequency of urban nature interaction in fall 2020 (during COVID-19), it was not associated with pre-pandemic frequency of urban nature interaction. This finding, combined with the fact that sense of belonging was significantly associated with change in frequency of urban nature interaction from 2019 to 2020, suggests that there is some interplay between sense of belonging in urban nature and the COVID-19 pandemic that has affected urban nature interaction. It may be the case that COVID-19 exacerbated the exclusion of Black and Latino residents from public spaces. For example, Hoover and Lim [32] describe how in New York City there were more police present in urban parks during COVID-19 to enforce social distancing between visitors. This increased police presence likely heightened the exclusion of Black individuals from those urban nature spaces [32].

Participants' income was not significantly associated with change in frequency of urban nature interaction as demonstrated with the stepwise regression analysis. Given the existing literature, one might have expected that income would be a significant independent variable. The fact that income was not suggests that the inequitable changes in frequency of urban nature interaction may be more closely tied to racial/ethnic inequities than income inequities.

Participants' sense of belonging in urban nature was found to be significantly associated with their level of importance of protecting urban nature. This may be due to the fact that those with a higher sense of belonging in urban nature are more likely to spend time in urban nature spaces and have meaningful experiences in urban nature. As some evidence has shown, meaningful experiences in nature may be associated with stronger conservation values [64-65].

In the coming handful of years, as COVID-19 either abates or becomes endemic, an open and important question is whether Black and Latino urban residents return to their pre-pandemic frequencies of urban nature interaction. Given the existing racial/ethnic disparities in urban nature, and urban environments in general, as well as the disproportional impacts that COVID-19 has had on Black and Latino communities, it seems possible that Black and Latino urban nature interaction will not fully recover. If this is the case, there are some large implications moving forward. The first is that inequities may grow in who benefits from urban nature. Additionally, as the less frequent urban nature interaction caused by the COVID-19 pandemic becomes the new normal, sense of belonging in urban nature among Black and Latino communities may decrease. With even fewer People of Color represented in nature spaces, the cycle of exclusion could be perpetuated, with inequities increasing.

4.1. Limitations

Achieving equal representation of the included racial/ethnic groups of this study allowed for comparisons between groups to be made with higher confidence. To logistically achieve equal representation, this study excluded several racial/ethnic groups including American Indian, Alaska Native, Native Hawaiian, and Pacific Islander individuals. Those who identified as belonging to more than one racial/ethnic group were also not eligible for participation. Research that includes and appropriately represents

these racial/ethnic groups is of importance in future research given that these racial/ethnic groups are frequently underrepresented or not represented at all.

Two other limitations are worth noting. First, when participants took the survey in winter 2020, they were asked to recall their experiences in fall 2019 and respond to certain questions accordingly. The pre-pandemic data is therefore not as reliable as it would have been had this been a longitudinal study with two data collection periods. Second, the Sense of Belonging in Urban Nature Questionnaire developed for this study, while achieving high internal reliability, remains unvalidated. Further exploratory and confirmatory factor analyses would be needed to validate this questionnaire.

5. Conclusions

The types of interactions participants engaged in prior to the pandemic and during the pandemic (presented in Table 2) may be of aid to city governments as they assess the potentially inequitable types of nature that different racial/ethnic groups have access to. In different parks in different locations, there should be equity, for example, in how the parks allow people to sit in nature, have a picnic, engage in sports, run or jog, ride a bike, walk a dog, sit, watch a sunset, watch one's children play, look out on a water view or a city view, tend to a garden, and/or simply enjoy the quietness of nature. This list is part of a larger approach to urban design – Interaction Pattern Design – that seeks to maximize ways for people not only to access nature, but to interact with that they access so that the interactions are engaging, meaningful, and self-reinforcing [66-69].

This list in Table 2 of interactions with nature can also provide some insights for how to design urban nature for future pandemics, and increasing density. For example, prior to the pandemic, Seattle residents took walks with other people more frequently than they took walks alone. Six months into the pandemic, residents took walks alone more frequently than with other people. This is likely due to social distancing mandates and attempts to limit risk of contracting COVID-19. Thus wide walking trails may be increasingly important to implement. They not only allow for social distancing during times of a pandemic, but create the urban nature infrastructure that plans for what, in most urban areas, will be increasing population density.

This study's results on sense of belonging can also be used by city governments. Everyone in a city should feel equally welcomed in their city's urban nature. Thus the six themes of the Sense of Belonging in Urban Nature Questionnaire—Ease of Access, Safety, Feeling Out of Place, Unwelcomeness, Institutional Acceptance, and Different Ways of Interacting with Nature Acceptance—are entry point for city governments to begin to decrease disparities in sense of belonging in urban nature. Examples of actions that city government agencies can take to target the inequity themes of the Sense of Belonging in Urban Nature Questionnaire include:

- Direct urban parks budget to urban nature spaces serving predominantly People of Color.
- Organize urban nature programming specifically for Black or Latino urban residents.
- Present urban nature information on signage and online in multiple languages.
- Increase representation of People of Color on urban park signage and websites.
- Improve racial/ethnic diversity of people hired into city government, especially departments which oversee urban nature areas (such as Parks and Recreation departments).

Environmental Government Organizations (EGO's), which often manage land that lies outside of city limits, can so benefit from the results of this urban nature study. EGO's (such as the Department of Fish and Wildlife, US Forest Service, and National Park Service), at least to some degree, rely on public interest in nature conservation in order to achieve their conservation goals on the lands that they oversee. With most of the US population living within cities and urban populations continuing to grow, it is crucial for EGO's to appeal to the urban population to maintain public support. Our results show that participants of this study who had a higher sense of belonging in urban nature

reported a higher level of importance of urban nature protection. Thus one way of increasing conservation values among city residents may be to increase peoples' sense of belonging in urban nature.

Supplementary Materials: The following supporting information can be downloaded at: www.mdpi.com/xxx/s1, Figure 1: Average sense of belonging in urban nature among each racial/ethnic group; Figure 2: Change to average frequency of urban nature interaction among each racial/ethnic group; Table 1: Sense of Belonging in Urban Nature Questionnaire; Table 2: Types of urban nature interaction before and during the COVID-19 pandemic; Table 3: Average measurement values across racial/ethnic groups; Table 4: Automated stepwise variable selection process.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to containing possibly sensitive participant information.

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